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ENVIRONMENTAL

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May 18, 2009

Mr. John Jones, P.E.
Director of Regulatory Management
Vertellus Specialties, Inc.
300 N. Meridian Street, Suite 1500
Indianapolis, IN 46204

Re: Review of STS/AECOM Groundwater Model
Update dated June 30, 2008
Reilly Tar & Chemical Superfund Site
St. Louis Park, Minnesota
August Mack Project Number JJ0286.350

Dear Mr. Jones:

August Mack is pleased to provide Vertellus Specialties Inc. (Vertellus) with our review of the STS/AECOM groundwater flow model entitled "Reilly Tar Site/Meadowbrook Groundwater Model Update" dated June 30, 2008 (groundwater model). Our analysis of the groundwater model is provided in the following sections.

Groundwater Modeling Review

August Mack has examined the groundwater model results presented in STS/AECOM's June 30, 2008 report. Based upon our examination of the report, August Mack has identified a number of estimating techniques and conservative assumptions that create issues with the groundwater modeling results that impact the model's ability to reasonably predict the eventual fate and transport of PAH compounds at the cities of St. Louis Park and Edina.

First, the MODFLOW model used to examine the groundwater flow and contaminant movement does not accurately or reasonably model fractured flow regimes. MODFLOW is intended for use with homogeneous and isotropic groundwater flow conditions. The modeling report indicates that the Prairie du Chien/Jordan Aquifer System (OPCJ) is a fractured bedrock aquifer. A finite element model such as FEFLOW is generally a more appropriate groundwater flow model for fractured flow.

Next, the modeling efforts described in the report is based upon the movement of volatile organic compounds (specifically chlorinated solvents) and not PAHs. Reilly is not a source of the VOCs discussed in the reports. The stated purpose of the model is to

"evaluate migration of the St. Louis Park centered OPCJ Aquifer VOC plume towards the City of Edina" and also to "evaluate various remedial actions to prevent the VOC plume from reaching the Edina OPCJ municipal wells. Although the report states that the VOC plume was found to coincide to a large extent with the PAH plume, the groundwater movement of PAHs is much different (primarily slower) than the movement of VOCs due to the different chemical characteristics of the two contaminant classes. For this and many other reasons presented herein, no conclusions concerning the potential movement of PAH in groundwater beneath the site or towards the City of Edina municipal wells should be inferred from the model. It is also unreasonable to predict the maximum future PAH concentrations at EW-13 and whether they will ever exceed DWC levels based upon the modeling results.

Next, the groundwater model was calibrated to the fewest water level measurements possible to determine a groundwater flow direction. The report indicates that for approximately two months in 2007 the groundwater flowed from St. Louis Park towards the City of Edina. The majority of the year, groundwater flow does not flow directly from St. Louis Park towards the City of Edina but frequently changes flow direction. This actual 10 month per year flow direction data which is away from the Edina wells was not accounted for in the model and only two months of water level readings (16% of a year) from three monitoring wells were used to calibrate the model and predict groundwater/contaminant movement. Three (3) monitoring well data collection points represent a very small calibration set for a flow model that represents the large area (approximately 54 square miles) used in the model. Using three calibration wells for 54 square miles (one well per 18 square miles) cannot provide a calibrated flow model that can be used to predict groundwater flow or contaminant movement to any degree of accuracy. According to the modeling report "This calculated calibration goal is based on the assumption of a uniform hydraulic gradient between the three wells – this is most likely an assumption only crudely corresponding to the real system conditions."

As also stated in the modeling report **"It is important to note that the results of predictive simulations discussed below are very conservative (they tend to over-predict VOC movement to the wells) because the simulations are based on assumption that the average hydraulic conductivity in OPCJ aquifer near the boundary between St. Louis Park and Edina calculated for October – November of 2007 does not change. In fact, as continuous water level monitoring data indicate (STS 2008a), hydraulic gradients and groundwater flow direction frequently change, contributing to a significant dispersion of the plume, which in turn results in decreasing contaminant concentrations. The predictive simulations explore and illustrate the worst case scenarios to identify the potential problems."** These statements confirm our assessment that the model was based upon a very narrow set of water level elevation data, the model does not accurately predict either groundwater movement and certainly cannot and will not predict PAH movement. The model's inability to predict the movement of PAH is especially true when the model's crude

approximation of groundwater flow conditions is used to project potential contaminant movement over multiple years, as has been by this modeling effort.

The modeling report also questions the location of the VOC plume even though VOC (or PAH) plume maps were not included in the report. The modeling report indicates the need for additional groundwater sampling in order to provide a current location for the southern extent of the VOC plume. The modeling report indicates that if the plume is where it is assumed to be located, the model predicts VOC impacts to City of Edina municipal wells. This is a vital consideration for determination of the need for pumping from the SLP-6 and W48 wells to provide hydraulic control to an unrelated source(s) of chlorinated constituents. The City of Edina is intending to install two new supply wells including ED-20 and either ED-21 or ED-21a (an alternative location for ED-21). The modeling report indicates that SLP-6 and W48 will have no influence upon ED-20 and ED-20 has no potential influence on contaminant migration. However, per the simulations, pumping at ED-21a may influence the flow regime and allow well ED-4 to capture particles (not necessarily contaminants it should be noted). But the modeling report further states that if the current VOC southern boundary is further north (other than where it is currently assumed to be located), pumping at ED-21a will not cause water particles to travel towards ED-4.

Reverse particle tracking was used to predict the potential movement of groundwater impacts. However, no fate and transport modeling was used to examine movement of contaminants towards the City of Edina municipal supply wells. PAH contaminants do not move in the same manner or at the same rate as groundwater. Reverse particle tracking predicts the possible extent of capture zones around recovery wells but this prediction is dependent upon an accurate groundwater flow model. This method requires for impacts to be located within the potential capture zones for contaminant migration to a particular pumping well to occur. For reasons previously discussed, the accuracy of the groundwater flow model is questionable. Also, since no PAH specific modeling was performed, the potential impacts of PAHs to the City of Edina municipal wells are unknown.

Based upon our analysis of the groundwater model results, the pumping of SLP-6 and W48 has not shown to be needed to prevent migration of PAH towards the City of Edina municipal wells. The stated purpose of pumping SLP-6 and W48 in the Focused Feasibility Study is to decrease VOC contamination from encroaching upon City of Edina. As stated previously, Reilly is not responsible for the VOC impacts detected near St. Louis Park. In addition, the modeling efforts were not performed and did not predict potential PAH migration.

Conclusions

August Mack has come to following conclusions based upon our review of the groundwater model.

- Multiple problems exist with the groundwater flow model which leads to questions concerning its accuracy to predict contaminant movement.
- The model is based upon VOCs movement not PAHs. PAHs will move much slower than VOCs in groundwater so the model does not predict potential PAH movement. Questions concerning the location of VOCs as it affects the need for SLP-6 and W48 for hydraulic control have been raised in the modeling report. If the VOCs are further north as postulated by the modeling report, SLP6 and W48 are not suitable for VOC control.
- The model uses reverse particle tracking to infer potential VOC impacts to City of Edina wells instead of using chemical specific fate and transport modeling. Reverse particle tracking cannot accurately predict the potential for PAH impacts at the City of Edina municipal wells.

August Mack trusts that this submittal meets with your approval. Please contact us if you have any questions or need any additional information.

Sincerely,

Timothy H. DeWitt, P.E.
Senior Engineer

Bryan K. Petriko, P.E.
Principal